SUSTAINABILITY MANAGEMENT PLAN

ECOTOURISM MIXED USE

LINNEAUS

Broken Head

WHO WE ARE

HIP V. HYPE Sustainability works with clients who are seeking exceptional sustainability outcomes and are willing to think strategically to achieve this.

We see sustainability as inherent to good design. It's not just an option, a differentiator or a marketing tool. At a global scale it is also, by definition, non-negotiable.

HIP V. HYPE Sustainability has been engaged by Planners North to develop this Sustainability Management Plan for the Linneaus Estate in Broken Head, NSW.

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DISCLAIMER:

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INTRODUCTION

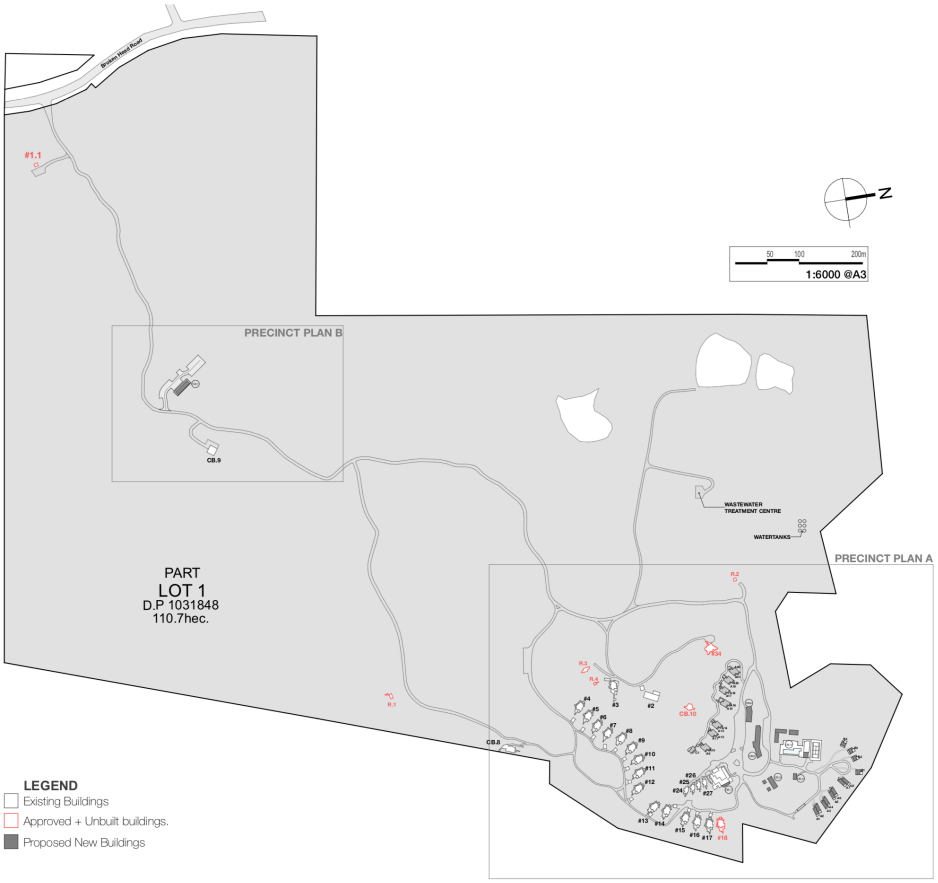
This Sustainability Management Plan (SMP) has been prepared for Linneaus Property in order to communicate the approach taken to embed sustainability into the design, construction and operation of the site as an Ecotourism facility.

The project seeks a new benchmark in genuinely sustainable tourism development in the region. Linneaus is committing to zero carbon energy and will target zero carbon for transport and waste.

A key component of this approach is an electricity system which is 100% renewable with the majority of energy needs being met with on-site solar generation.

Beyond carbon, every aspect of the guest experience is seen as an opportunity to reduce environmental impact.

The design responses detailed in this SMP effectively integrated sustainability in this context and will deliver reductions in carbon emissions associated with electricity and transportation, improve resource efficiency, while minimising impact or enhancing natural systems consistent with climate resilient principles.



LOCATION PLAN FOR THE LINNEAUS ESTATE (HARLEY GRAHAM ARCHITECTS)

IMAGE: LOOKING SOUTH TOWARDS SEVEN MILE BEACH AND LENNOX HEAD.

PROJECT INFORMATION AND CONTEXT

Municipality: Byron Shire, New South Wales

We recognise the intrinsic connection of Traditional Owners to Country and value their contribution to managing the land, water, natural and built landscapes.

Project Information:

Project Name	Ecotourism Mixed Use
Project Address	951 Broken Head Road, Byron Bay
Applicant	Planners North, 6 Porter Street, Byron Bay NSW, 2481
Site area	111.2 Ha
Architect	Harley Graham Architects
Proposal	Mixed Use Development of the Linnaeus property permitting certain of the existing facilities to continue to be used for Private Education; allowing the remaining existing facilities to also be used for eco-tourism and providing further new facilities for Eco Tourism purposes.
Proponent	Linneaus Property

ENVIRONMENTALLY SUSTAINABLE DESIGN

KEY INITIATIVES:

_ The construction Management Plan will include a target to divert at least 90% of construction waste from landfill (recycle or reuse)

_ A Guest Welcome Pack will be developed to communicate the broader environmental values and features of the site and tourism facility

_ Accommodation units designed and orientation maximised to solar access and natural ventilation (passive design), with high performance facades and efficient appliances specified throughout

_ Approximately 250kW of solar PV to be located on distributed rooftops throughout the development - equating to 100% of the summer consumption

_ The existing water-system (which is self-sufficient) will be scaled up to cater for proposed increased capacity, with on-lot rainwater tanks installed to service immediate landscape irrigation and toilet flushing (minimum 700L per accommodation unit)

_ Comprehensive strategy regarding operational waste, including: 'zero-waste' consumables for accommodation units, and multiple waste streams including a strategy for organics to be integrated with food producing garden

_ A full life cycle analysis (LCA) for the development will be undertaken as part of the detailed design process when selection of internal materials is more advanced

_ Transport will use electric vehicles where possible, including: EV airport transfers (on request), 2x EV on-site for guest use, E-bikes and electric golf carts

_ Native or adaptive plant species will be specified to reduce maintenance requirements associated with upkeep, irrigation, and pest management

GOVERNANCE AND MANAGEMENT

Linneaus Property is committed to integrating sustainability, not only during the construction phase, but throughout the operation and occupancy of the site. Both Construction, and Operational Management Plans are proposed to guide initiatives around environmental protection, construction methods, waste minimisation and staff education.

For guests, a Welcome Pack will be developed to communicate techniques to reduce environmental impact, while also championing activities that can contribute positively to the environment both on site and off site. This includes how the guests can connect with nature during their stay.

Objectives:

- **Reduce the environmental impact of the construction phase**
- **Reduce the environmental impact of the operational phase**
- **Preserve and enhance the biodiversity values of the site**
- **Ensure that guests of the facility are educated and participate in the environmental management practices**

OPPORTUNITY AREA	MEASURES ADOPTED	VALUE & IMPACT
CONSTRUCTION MANAGEMENT	_ Commit to development of a Construction Management Plan which: + Outlines sustainability risks and opportunities which will be monitored through the construction process + Includes measures to ensure stormwater quality is maintained through the construction phase + Protects existing vegetation via tree protection zones + Includes provision for site induction which emphases the environmental value of the land + Confirms construction waste practices + Recognises the existence of fauna habitat on the site _ A dedicated role to manage environmental impacts of the construction phase _ Adoption of offsite construction of accommodation units to ensure minimum construction impact on site _ Construction tender evaluation criteria to emphasise environmental credentials of construction firm	Of the 20 million tons of construction and demolition waste generated in Australia in 2014-15, only 64% was recovered for recycling and re-use[1]. Managing construction inputs and materiality, construction methods and waste stream separation is vital to ensure buildings are constructed in a sustainable manner.

1. Australian National Waste Report 2016, Department of the Environment and Energy

OPPORTUNITY AREA	MEASURES ADOPTED	VALUE & IMPACT
OPERATIONAL MANAGEMENT	_ An operational management plan will be developed to include: + Outlines sustainability risks and opportunities which will be monitored through the operational phase including the ongoing commitment to zero carbon energy + Staff induction and education to emphasise environmental management of the land (e.g. zero waste practices, use of chemicals, habitat zones) + Procurement policy to emphasise sustainable purchasing + Commissioning and maintenance of buildings and infrastructure to ensure efficient ongoing operation (e.g. filters, grease traps) _ Building Management System (BMS) which allows oversight of energy and water use (HVAC in unoccupied units, leak detection etc)	Approximately 75% of the environmental footprint of development is during the operational phase. Best practice operational practices can ensure that measures taken during the design and construction phases of the development are operated efficiently and through a lens of continuous improvement.
GUEST MANAGEMENT AND EDUCATION	_ A Guest Welcome Pack will be developed to communicate the broader environmental values and features of the site and tourism facility. This will also include: + Practices to minimise energy use on site (shut-down switches in accommodation, fan use instead of air-con etc) + Practices to reduce waste including communication about the three waste streams in accommodation units + Practices to reduce water use (e.g. towel replacement) + Practices to minimise travel related carbon emissions such as use of electric vehicles _ Programming of guest activities will emphasise environmental values and features of the facility including 'paddock to plate' cooking, environmental walking tours, revegetation etc.	Guests have a critical role in helping to manage the environmental impacts of the facility. Additionally environmental practices learned and adopted on holiday can help inform everyday practices at home.

ZERO CARBON

Energy efficiency is embedded within proposed development - the product of an effective response to environmental factors, early strategic thinking and a considered approach to construction.

The Linneaus Property Ecotourism Mixed Use proposal has been conceived with awareness of ongoing energy use and the associated carbon impact. This has led to passive design being adopted as a core design driver allowing the internal amenity and comfort of guests to be achieved with minimum energy use.

System and appliance choices consider energy efficiency as a key decision parameter.

Additionally, a zero carbon energy commitment has been made for operation meaning that energy consumption on site not catered for by the significant investment in solar PV and storage will be sourced from renewable sources.

Objectives:

_ High levels of passive thermal performance

_ Highly efficient systems and appliances

_ Zero net energy (all operational energy is renewably sourced either from on site or off site)

IMAGE: LINNEAUS PROPERTY AIMS TO ACHIEVE ZERO CARBON THROUGH PASSIVELY DESIGNED, ACCOMMODATION UNITS AND AN INTEGRATED NETWORK OF SUSTAINABLE TRANSPORT OPTIONS TO AND FROM AND WITHIN THE SITE SOURCE: HARLEY GRAHAM ARCHITECTS

OPPORTUNITY AREA	MEASURES ADOPTED	VALUE & IMPACT
MAXIMISE PASSIVE THERMAL PERFORMANCE	_ Living areas orientated for best solar orientation, subject to importance of capturing views and working with the challenging topography _ Excellent cross flow ventilation with dual aspects on all dwellings and key buildings. Dwellings elevated to capture breezes and louvred high level windows to encourage air flow and minimum cooling energy required _ Insulation is appropriate for climate, noting the balance between increasing cost, the effort in passive ventilation and proximity to sea breezes _ Daylighting has been with maximised to living areas and has been balanced with shading levels _ High efficiency ceiling fans to all bedrooms and living areas with reverse air function for heating and cooling _ High performance façades (all conditioned areas): + External walls with ≥R2.5 insulation + Floor below with ~R1.0 + Roof ~R3.5 at all exposed ceiling/roof + Exhaust fans with self-closing dampers + U-value of ~4.5 - clear single low-e + All windows openable for natural ventilation + Glazing with high visible light transmittance for improved daylighting _ Offsite build of villas ensures that higher air tightness levels can be met _ Refuge building thermal fabric to be driven by bushfire requirements _ Shading will be provided to all north, east and western facades - either through operable shading (e.g sliding louvres), fixed weather protection (balconies eaves etc) or landscaping for seasonal heat control	Strong thermal performance is central to an energy efficient building. For example, a 7.0 star NatHERS home is projected to consume approximately 28% less energy for space conditioning than a 6 star home[1]. Effective passive thermal design also contributes to a more comfortable, healthier building and living environment through maintaining comfortable, stable temperatures and reducing condensation issues.

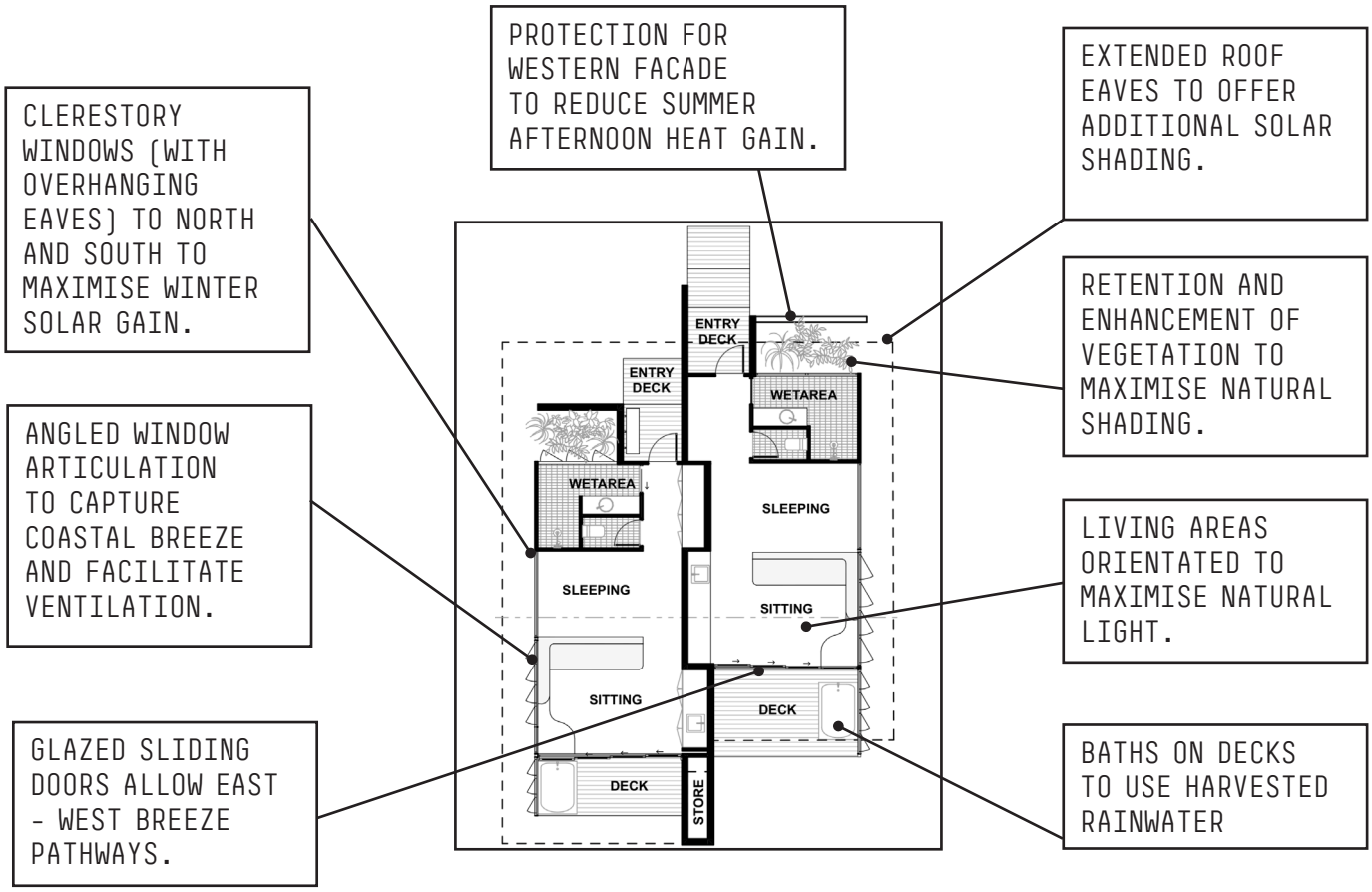


IMAGE: THE DIAGRAM OUTLINES THE KEY THERMAL PERFORMANCE FEATURES OF AN INDICATIVE ACCOMMODATION UNIT

OPPORTUNITY AREA	MEASURES ADOPTED	VALUE & IMPACT
EFFICIENT SYSTEMS AND APPLIANCES	_ High efficiency reverse cycle heating / cooling, target 5 star minimum (where below 4kW in accommodation units) _ Any new commercial heating and cooling equipment to be highly efficient (within 15% of the best available) _ Highly efficient bar refrigerators based on kWh/annum usage, rather just star rating, capacity matched to occupancy level. _ Hot water: Heat pump (Sanden or similar) with tank capacity to match heating loads. Hot water systems (likely 315L) will be generally shared between two accommodation units and timed to heat during peak solar generation _ LED lighting throughout (wall light, oyster or pendant) for all buildings	Providing high efficiency HVAC system and minimising gas use on site helps carbon emissions of the development

OPPORTUNITY AREA	MEASURES ADOPTED	VALUE & IMPACT
EFFICIENT SYSTEMS AND APPLIANCES (CONT.)	_ Daylight and motion sensors for all external lighting and low use space including circulation. _ Any new commercial refrigeration to be highly efficient (within 15% of the best available locally sold systems) _ Existing gas cooking in commercial kitchen to be retained (to avoid embodied energy) but replaced at end of life with best available electric induction cooking _ BMS to control energy use remotely, linked to occupancy sensors in villas and with the ability to modify HVAC settings back to defaults and turn off heat pumps for periods of low occupancy _ Guest welcome pack to include energy saving information _ Pool to be covered using thermal blanket overnight _ Heating approach for pool to use combination of highly efficient heat pump and (ground source heat pump or solar PV) _ A highly efficient heating approach will be developed for the sauna during the detailed design stage	Thermal pool covers can halve the heating requirements of swimming pools
RENEWABLE ENERGY GENERATION AND STORAGE	_ An approximate 250kW solar PV system will be located on distributed rooftops throughout the development maximising the delivery of electricity to the source of the consumption. With energy efficiency measures applied, this equates to 100% of the summer consumption (when solar output is at its highest) and over 40% of winter consumption (when solar output is lower). _ The surplus energy generated by the solar PV system will be stored in a proposed 700 to 1000kWh of battery storage to be distributed throughout the development consistent with the solar PV locations _ The residual energy sourced over winter from the electricity grid will be 100% renewable.	Generating energy on-site reduces the dependency and ongoing costs associated with traditional 'mains' electricity, while increasing the sites adaptive capacity in a changing climate The energy consumption which is either avoided entirely or matched to a renewable source is over 500,000kWh per annum, meaning with the proposed combination of energy efficiency and renewable energy 477 tonnes of CO2e annually is avoided.

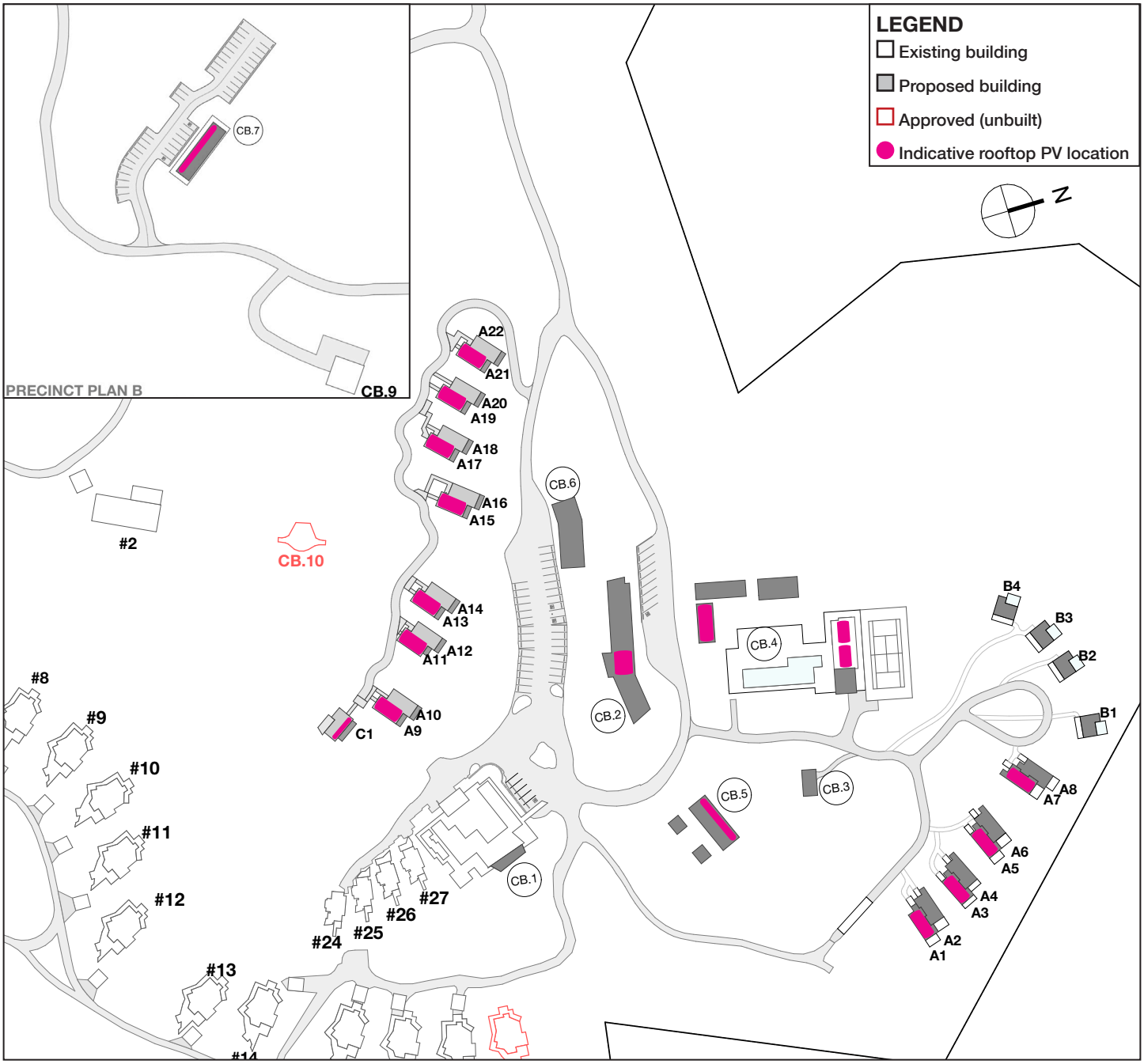


IMAGE: THIS SITE LAYOUT DIAGRAM DEMONSTRATES INDICATIVE ROOFTOP ZONE, WITH THE LOCATION OF SUITABLE BATTERY STORAGE TO BE CONFIRMED THROUGH THE DETAILED DESIGN STAGE.

SUSTAINABLE WATER

The water approach for the site is built around self-sufficiency. A considered approach is required to ensure this self-sufficiency is maintained with increased utilisation of the land.

Beyond efficient fixtures and internal services, alternative water sources are drawn from the Class A recycled water supply on site and proposed collection and reuse in accommodation units.

Stormwater management is undertaken through an enhancement to the existing stormwater networks (refer Geolink Report) The strategy maintains flows above ground mirroring the existing conditions as much as possible (elevated accommodation, minimal hardstands).

Objectives:

_ High water efficiency tapware and fixtures embedded in all buildings

_ Maintain self sufficiency for water supply using on site detention and treatment

_ Ensure landscape approach is drought resilient

_ Treat run off to best practice

IMAGE: AN ON-SITE EFFLUENT STORAGE DAM (HIGHLIGHTED)

CONSIDERATIONS	MEASURES ADOPTED	VALUE & IMPACT
REDUCING WATER CONSUMPTION	_ Water efficiency target per guest per occupied day consistent with the overall allowable water demand for the site _ Water fittings: Minimum WELS ratings: 3-star shower; 5-star toilet; 4-star taps _ Medium sized baths in standard accommodation units _ Laundry to be managed off-site with tender evaluation criteria relating to water reuse and other environmental considerations _ Drought tolerant landscape design and plant species selection (refer to Landscape Plan and Report). Climate predictions for increased average and extreme temperatures have been a driver for design. _ Guest Welcome pack to incorporate measures to save water use (e.g. towel replacement, bath use)	Decreasing the consumption of potable water through efficient fixtures and design reduces reliance on valuable water resources. Communicating water sensitive approach to guests promotes potential for adoption of water saving techniques beyond the direct impact on site.
STORMWATER MANAGEMENT	_ Greater than 90% permeable surfaces and natural run-off _ On-site bioretention swales, allowing for collection and filtration of stormwater, and use for irrigation (refer more information in Geolink report) _ Sewage treatment plant on site which treats waste before passing it to infiltration beds (refer more information in Geolink report)	Effective Stormwater management reduces flow rates and (potentially contaminated) run off during flood events, which in turn improves the quality of stormwater. Reusing stormwater off buildings creates a valuable additional water resource.
WATER RE-USE	_ Scale up of the existing current water-system (which is self-sufficient) to cater for proposed increased capacity (refer more information in Geolink report) _ Rainwater tank(s) will collect water from roof areas and plumb this directly to landscape irrigation and toilets around each cabin. Further feasibility will dictate exact location and whether a large number of small tanks or fewer larger tanks will be provided. At least 700Ltrs of capacity will be provided for each accommodation unit.	The use of rainwater tanks to capture and reuse stormwater is essential in reducing potable water use, by providing an alternative supply of water for toilet flushing (when filtered), or irrigating landscape features (if unfiltered, or ‘grey’ water). The modelled benefit of on-site collection and reuse associated with the accommodation units is approximately 490kL per year.

RESOURCES (MATERIALS & WASTE)

New buildings and infrastructure generate significant waste during both construction and operation.

Adopting a circular economy or resource wise approach can limit environmental impact through reducing the amount of resources and adopting a sustainable materials protocol to construct the development.

Through the operational phase, ensuring that procurement as well as managing all waste streams is critical due to the high degree of control over resource use in the operation of a tourism facility.

Objectives:

_ 90% construction waste diverted from landfill.

_ 'Zero Waste' kitchen and bathrooms for guests

_ Use of local and recycled materials where possible, and use of materials that minimise whole of life cycle impacts.

IMAGE: PREFABRICATION ALLOWS CONSTRUCTION TO OCCUR OFF-SITE IN CONTROLLED ENVIRONMENTS, MINIMISING WASTE AND DISRUPTION TO ON-SITE VEGETATION AND ECOSYSTEMS (SOURCE: BLOK MODULAR)

CONSIDERATIONS	MEASURES ADOPTED	VALUE & IMPACT
MINIMISE WASTE GENERATED AND SENT TO LANDFILL DURING CONSTRUCTION	_ The construction tender will include a requirement for 90% by volume of construction waste to be diverted from landfill (i.e. reused, recycled) _ Accommodation units will be constructed offsite - significantly decreasing the waste associated with construction	In addition to managing waste outputs, methods such as prefabrication see construction take place in controlled environments that reduce material transport, the consumption of raw materials and landfill emission.
WASTE DURING OPERATION	_ Two 'in built' waste streams (general and recycling) and a 'kitchen caddy' for organic waste will be provided in accommodation _ A 'zero waste' kitchen and bathroom will be provided where consumables (e.g. Bar fridge contents and soaps) are provided in reusable containers _ Three waste streams will be collected for communal areas. A composting system will be designed as part of the food garden area to accommodate a proportion of food waste per day (exact volumes subject to detailed design). An arrangement with an external organics processor or farmer will be sought for ensuring carbon emissions associated with any additional organics waste are avoided. _ Operational management plan will commit to ensuring no unrecyclable single use plastics for food and beverage for the entire facility. _ Operational management plan will commit to natural and ecologically sensitive materials and products (such as soaps and detergents, linen and other similar fabrics for table-cloth etc). _ Fugitive wastewater emissions will be calculated as part of the commitment the commitment to zero carbon and offset either on site through revegation or through an offset program _ Guest welcome pack to provide guidance to guests on operational waste	Managing waste during operation to ensure the waste streams are optimised for resource recovery can reduce the costs associated with collection and disposal, while creating value in other areas, such as the economic value of organic waste as compost and energy. The success of such an initiative depends on the design of waste disposal/ separation infrastructure and the procurement of resources with minimal or no packaging. The average restaurant wastes 120g of food per serve. Based on a maximum occupancy of 172 guests and 20 staff with an average of two 'covers' per day this would result in up to 46kg of wasted food per day. With food waste avoidance measures in place (e.g. growing food on site) this wastage can be significantly reduced.
RECLAIMED OR RECYCLED MATERIALS	_ Existing buildings and infrastructure are all retained for new use, significantly reducing embodied energy requirements for the development	Reusing materials where possible reduces the total quantity of (new) materials procured, therefore reducing the subsequent embodied energy of materials required.

CONSIDERATIONS	MEASURES ADOPTED	VALUE & IMPACT
MATERIAL SPECIFICATION	_ A palette of highly sustainable materials has been selected. The table in Appendix A outlines the palette of key external materials and the embodied energy, durability and future recyclability associated. _ Commit to a sustainable materials protocol for internal materials, consisting of a principles based approach to local sourcing, low embodied energy, low toxicity including: + Specify low or zero VOC paints, materials, adhesives and finishes throughout. + Minimise use of MDF and/or specify use of low VOC (E0) with no added formaldehyde particleboard. + Minimise or eliminate specification of PVC materials and finishes to limit off-gassing exposure.	Sustainability implies ethical procurement as well as the durability of materials. Due to the sites exposure to various coastal and tropical elements, external materials have been sourced with durability in mind.
LIFE CYCLE ANALYSIS	_ A full life cycle analysis (LCA) for the development will be undertaken as part of the detailed design process when selection of internal materials is more advanced.	Materials have an impact during their production and procurement, their use and operation and finally during demolition and disposal. Considering this, and selecting materials that minimise their impact at each stage contributes to creating a standard of sustainability that extends throughout the life cycle of the development. See Appendix A on page 22.

SUSTAINABLE TRANSPORT

The masterplan for Linneaus developed by HGA Architects capitalises on the site's relatively compact established private road network.

Sustainable modes of transport are encouraged with the only on site modes of transport provided all electric and guaranteed 100% renewable.

Travel to the site is managed through a series of strategies related to guest and staff travel.

Objectives:

- **A highly walkable compact development where guest needs are met predominantly on site**
- **An all electric transport fleet and support for guests to make sustainable transport decisions**

IMAGE: NEW ELECTRIC VEHICLE SOLUTIONS SUCH AS THE JAUNT EV DEFENDER (PICTURED) STRIKE THE BALANCE BETWEEN SUSTAINABILITY AND FUNCTIONAL MOBILITY (SOURCE: JAUNT MOTORS)

CONSIDERATIONS	MEASURES ADOPTED	VALUE & IMPACT
ACTIVE TRANSPORT	_ Electric bicycles will be available for guests to travel internally on-site/to beach externally to Byron Bay, or tours. _ Car movements within the site will be restricted to deliveries and operations only creating an environment conducive to walking and cycling.	Providing guests with low-carbon transport options, and encouraging cycling and pedestrian movements contributes significantly to reducing carbon associated with the operation of the facility.
STAFF TRAVEL	_ Undercover bike storage will be available within the front gate to allow staff to access the main part of the site through a combination of public transport and bike _ A car pooling program for staff will be facilitated through the Operational Management Plan for the site	Active transport modes support lower greenhouse gas emissions and air pollution.
ELECTRIC VEHICLES	_ Airport transfers using an electric vehicle will be made available to facility guests who are not hiring their own cars _ A partnership will be sought with a car hire / car-share company to supply an Electric Vehicle (EV) or Plugin Hybrid Electric Vehicle (PHEV) deal for Linneaus guests - promoting a reduction in the carbon emissions associated with guest travel offsite _ Two on-site electric vehicles will be available for guests for day trips or for Linneaus to run off-site tours _ Electric bicycles provided for guest movements and charging will be provided for with each villa. _ Electric golf buggies for staff movements (cleaning, room service etc) _ Level 2 charging infrastructure for electric vehicles will be provided in conjunction with the Depot Building for at least three parking bays and Level 1 charging infrastructure will be provided for at least six other parking bays	The provision of EV infrastructure encourages and supports transitioning towards electric vehicles.

ECOLOGY

The impact of development on land use and biodiversity, and the best way to have a positive impact on this, varies dramatically according to context.

The low impact nature of the Linneaus development and the design of the architecture to ‘sit in nature’ allows the use of the site to evolve whilst adhering to best practice environmental management principles.

The operation of the facility will communicate and educate guests on the environmental custodianship of the land as a key component of the guest experience.

Key Objectives:

_ Mitigate urban heat island effect.

_ Protect existing terrestrial and marine ecology

_ Specify local indigenous and native species to contribute to local biodiversity.

IMAGE: LINNEAUS AIMS TO CONSERVE AND ENHANCE LOCAL ECOLOGY THROUGH WEED CONTROL AND NATIVE VEGETATION PLANTING AND RESTORATION.

CONSIDERATIONS	MEASURES ADOPTED	VALUE & IMPACT
CLIMATE RESILIENT LANDSCAPING	_ Native or adaptive species will be specified to reduce maintenance requirements associated with upkeep, irrigation, and pest management (refer to Landscape Plan and report for more information) _ Vegetation zones located around accommodation units to provide for season heat control within units and to reduce ambient heat	Urban heat island impacts cause increases in the use of air conditioning and creates human health risks. The provision of low density built form and landscaping with canopy coverage naturally reduces these impacts.
LOCAL FOOD PRODUCTION	_ A target of 80% of vegetables and herbs used in fresh food to be farmed on site _ A target of 80% of remainder (by weight) sourced from farmers in the Northern Rivers (subject to supply chain establishment) _ Operational Management Plan to prioritise local sourcing of all other foods	Growing food on-site or locally will reduce the 'food miles' and carbon emissions associated with traditional food supply chains and provide economic opportunities for local food producers and communities.
FLORA AND FAUNA	_ Ensure activities offered adhere to Marine Park Zoning re: Environmental Protection _ Commitment to explore potential of on-site opportunities to offset operational carbon _ Protection of on-site flora including 'Littoral Rainforest' (see biodiversity assessment) _ A 1:10 replacement ratio for tree removal resulting for the loss of native trees.	Protection of habitat species maintains and provides the opportunity to enhance a thriving local ecosystem.
LIGHT POLLUTION	_ Design external luminaires on the project so that upward light output ratios do not exceed 5%, relative to its actual mounted orientation	

APPENDIX A - EXTERNAL MATERIALS REVIEW

MATERIAL	PROCUREMENT & REUSE	EMBODIED ENERGY	DURABILITY	RECOMMENDATION
MRS.2_Copper Roof [Extent of use limited to new roof over deck on CB1, to match existing]	_ Closest copper mine is approximately 950km away in Murrawombi _ Highly recycled product, particularly for architectural uses.	_ 'External wall cladding copper metal sheet 1mm' - 34 GWP*[1] _ 70.6 MJ/kg[2]	_ Life-span of 70 to 100 years depending on location and conditions. _ Highly resistent, naturally forming a protective layer (patina) to withstand corrosive environments	_ Boasts significant fire resistant qualities with minimal maintenance required. _ If copper products become unavailable or too costly, colourbond is a good replacement option.
MRS.1_Metal Roof Sheet	_ Metal Sheeting produced in Australia from Australian steel. Lysaght for example, a subsidiary of BlueScope Steel, produces metal Colourbond sheeting out of Newcastle plant. _ Steel sheeting is highly reusable and 100% recyclable (current products up to 40% recycled content)	_ 'Steel Sheeting 0.42mm corrugated' - 39 GWP[1] _ 'Steel, general' - 32 MJ/kg[2]	_ Galvanised can last up to 100 years, but is vulnerable to salt erosion. _ Colourbond can last approximately 50 years and is recommended for buildings within 100m of coast. _ Care has to be taken between metal components (fasteners) to ensure steel-compatibility to avoid corrosion.	_ Colourbond recommended for coastal environments. _ Standing seam (or snap lock seam) over traditional corrugated overlap to increase thermal performance. _ Ensure SRI can adequately reflect solar radiation (to improve cooling load and ambient heat around building).
MWS.1_Metal Wall Sheet		_ 'Wall Cladding - corrugated steel' - 26.94 GWP[1] _ 'Steel, galvanised' - 34.8 MJ/kg[2]		_ For walls, consider recycled corrugated panels to lower embodied energy and align with rustic aesthetic. Presumed initial higher costs for procurement and installation. _ See Fig 1 below
MWS.2_Cor-ten Steel Cladding	_ Potential for local (reclaimed) procurement, however most likely manufactured in Woolongong by BlueScope steel. _ BlueScope manufactures both XLERPLATE & REDCOR steel products in various sizes.	_ 'Steel base plate + anchor studs' - 46 GWP[1]	_ Life-span of up to 150 years depending on application. _ Often used for its rusty patina, unusually high rates of corrosion may occur in chlorine or marine environments - consider sealing.	_ No replacement with similar 'look and feel'. Okay to use, but with limited application. _ Avoid aluminium 'faux weathered' products due to high embodied energy.
TC.1_Timber Cladding (Spotted gum or Blackbutt) **TB_Timber Battens**	_ Significant timber plantation between Byron Bay and Coffs Harbour, however mainly for Adiata Pine (softwood). _ Consider locally procured, or recycled timber. _ Harvested wood products store carbon - up to the equivalent of 1.28 tonnes carbon dioxide (tCO2-e) per tonne of wood.[3] _ At a carbon price of $30 per tonne, the impact (as a percentage of the price per tonne of material) is less than 1% for rough sawn hardwood and softwood, compared to blast- furnace steel (10%), cement (16%), and aluminium (18%).[3]	_ 'Wall Cladding, sawn hardwood (25mm)' - 24.09 GWP[1] _ 'Hardwood Timber (air dried, rough sawn) - 0.50 MJ/kg[2] _ Embodied energy varies greatly depending on whether recycle and the extent of treatment.	_ Lasts 20-60 years depending on timber, maintenance and application. _ Resistance to salt also dependant upon timber quality and treatment.	_ Recommend procuring recycled timber cladding. It maintains its previously captured carbon, however may be more expensive and labour intensive to procure, refurbish and install. _ Ensure compliance with FSC or PEFC. _ Local suppliers such as: https://www.northernriverstimber.com.au/ and https://www.oldmill.com.au/ _ See Fig 1 below.

**Note: Global Warming Potential (GWP) is a metric (presented in $KgCo^2$) that summarises the materials impact on emissions, including manufacturing and transport.*

1. eTool LCD, 2020
2. Victoria University Wellington (NZ), Embodied Energy Coefficients
3. Forest&Wood Products Australia, Impact of carbon trading on wood products

MATERIAL	PROCUREMENT & REUSE	EMBODIED ENERGY	DURABILITY	RECOMMENDATION
LC.1_Composite Timber Panel	_ Composite wood panel and cladding products vary depending on manufacturer. _ Weathertex produces Australian Made composite materials (97% hardwood, 3% natural wax) out of Newcastle.	_ No comparable product on eToolLCD.	_ Weathertex has a 25 year guarantee, the addition of natural wax increases its ability to resist water. _ Composite materials are often pre-treated and offer more resilience to coastal environments. _ Minimal risk of corrosion, termites and thermal expansion/contraction.	_ Avoid petroleum based composite boards. _ Natural composites like Weathertex offers similar benefits but without the impacts. _ Recycled and/or hardwood cladding is preferred (noting maintenance issues). _ See Fig 1 below
FC.1_Fibre Cement Cladding	_ CRS products (Cemintel) manufactured at Wetherill Park plant in New South Wales.	_ 'Wall Cladding, 9mm compressed fibre cement board' - 61.4 GWP[1] _ 'Fibre cement board' - 9.5 MJ/kg[2]	_ Approximate life-span of 60 years, with 10-year warranty on products like Cemintel. _ Highly resistant to salt and coastal applications.	_ Avoid aluminium cladding options due to their high embodied energy. _ See Fig 1 below.
ST_Natural Stone	_ Stone that is natural to Byron Shire includes; Weathered Basalt (bush rock) and Sandstone. Both of which are quarried locally. _ Sandstone potentially 70 km from the site at Swan Bay Quarry Supplies, Raw or cut to shape.	_ 'Limestone Wall, 250mm thick, with concrete mortar' - 152 GWP[1] _ LOCAL stone - 0.79 MJ/kg[2] _ IMPORTED stone - 6.8 MJ/kg[2]	_ Estimates range from 60-150 years depending on rock type, thickness, application and maintenance. _ Appropriate for coastal locations.	_ Procure locally, environmental impacts increase dramatically with transport due to weight. _ Avoid concrete pavers/blocks due to their larger embodied carbon, increased costs to produce and artificial appearance.

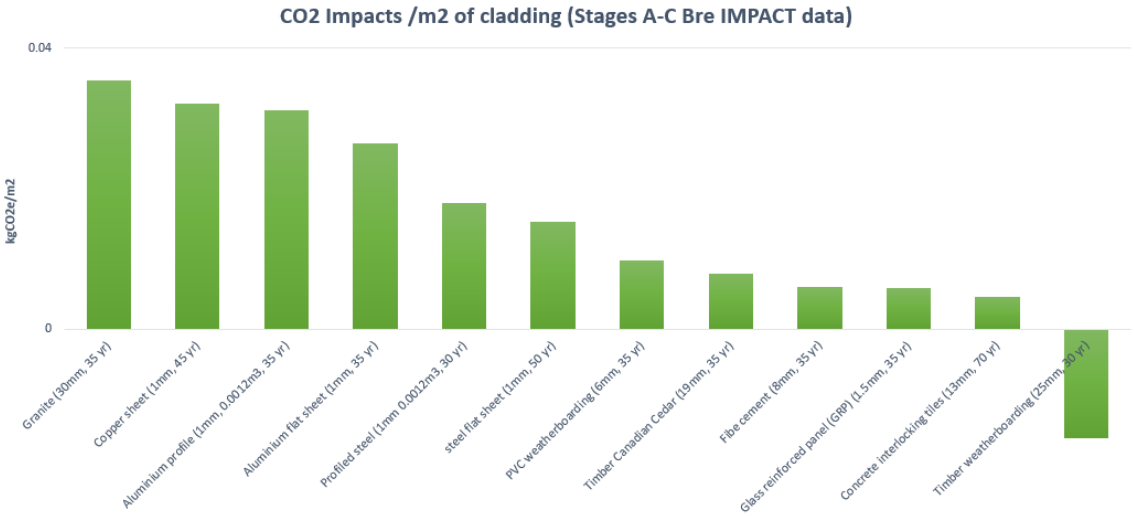


FIG 1: HIERARCHY OF BASIC CLADDING OPTIONS. TIMBER CLASSING SHOULD BE UTILISED WHEREVER POSSIBLE SOURCE: ETOOLLCD

1. eTool LCD, 2020
2. Victoria University Wellington (NZ), Embodied Energy Coefficients

HIP V. HYPE SUSTAINABILITY

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WE RESPECTFULLY ACKNOWLEDGE THAT EVERY PROJECT ENABLED OR ASSISTED BY HIP V. HYPE IN AUSTRALIA EXISTS ON TRADITIONAL ABORIGINAL LANDS WHICH HAVE BEEN SUSTAINED FOR THOUSANDS OF YEARS.

WE HONOUR THEIR ONGOING CONNECTION TO THESE LANDS, AND SEEK TO RESPECTFULLY ACKNOWLEDGE THE TRADITIONAL CUSTODIANS IN OUR WORK.